Simultaneous Linear Equations

Level: Key Stage 3

Dimension: Number and Algebra
Module: Algebraic Relations and Functions
Unit: Linear Equations in Two Unknowns

Student ability: Average

Content Objectives:

After completing the activity, students should be able to:

- ●understand the relationship between the intersecting point of two straight lines and the solution of the two simultaneous equations of the straight lines; and

- ●understand how to find the solution of two simultaneous linear equations by the graphical method.

Language Objectives:

After completing the activity, students should be able to:

- understand the key English terms related to the topic (e.g., *solve, find the solution of, simultaneous linear equations, at the same time, condition, the method of substitution, the method of elimination, the graphical method, plot graphs, locate, the point of intersection, observation, conclusion, drawbacks, disadvantage, exact);*

- understand the English expressions for explaining the graphical method, e.g.,

  - *The intersection point of the graph of the two linear equations is the solution of the simultaneous linear equations.*

  - *Solving a pair of simultaneous equations is equivalent to finding the location of the point of intersection of two straight lines.*

- understand and use the English expressions to discuss the drawbacks of using the graphical method to solve simultaneous linear equations, e.g.,

  - *The disadvantage of the graphical method is that it is difficult to locate the exact intersection point when the coordinates are not integers.*

  - *A drawback of using the graphical method is that it is time consuming to draw the graph.*

  - *Another drawback is that reading the solution from the graph may not be accurate.*

- follow English instructions on solving problems concerning this topic and work on related problems written in English.

Prerequisite knowledge:

Students should have learned through the medium of Chinese how to:

       1) plot linear graphs in rectangular coordinates; and

       2) solve simultaneous linear equations by the elimination or substitution methods

Time: 1 lessons (40 minutes)

Procedure:

1. The teacher should first ask students to complete question 1 (using the elimination method) and check the answers with them.

2. The teacher should then remind students how to plot graphs of linear equations. Then the teacher should ask the students to complete question 2 (in which they plot the graphs and locate the point of intersection).

3. The teacher should then ask students to write down their own observation from the answers to questions 1 and 2.

4. Then the teacher can give students three minutes to discuss their observations with their partners before asking some pairs to present their observations to the class. Then, the teacher should draw conclusions from the activities, summing up the key points.

5. Students then do question 6 for practice.

6. Finally, the teacher should discuss the drawbacks of the graphical method with the students.

Explanatory Notes for Teachers:

1. Question 1 is used to familiarize students with the content previously taught through the medium of Chinese (the method of elimination). This lesson will continue to develop these ideas and teach the third method of solving simultaneous linear equations using English as the medium of instruction.

2. In question 2, the teacher has to remind students of what they have learnt previously about plotting graphs. The teacher should also remind students of the meaning of each point on

the line as they are the solutions to the equations. The difference is that, this time, we plot two lines on the same graph.

3. The teacher can guide the students to compare the answers (the solution of x and y from questions 1 (a)-(c) and the intersection points from questions 2 (a)-(c)). It is not difficult for students to discover that they are the same.

4. After learning the concept of "simultaneous" in the previous lessons taught in Chinese, students may be able to explain why the answers are the same in Chinese. However, they may have difficulty in explaining this in English. The teacher can support and encourage them to do so by providing vocabulary support (e.g. by teaching them key terms such as "at the same time", "condition", "intersection" and "solution").

5. After expressing their views, the teacher should use English to draw conclusions about the concepts students have been exploring. As every point on the straight line of the first equation is a solution to the first equation and at the same time, every point on the straight line of the second equation is a solution to the second equation, the intersection point is a solution to both equations. Thus, the intersection point of the graph of the two linear equations is the solution of the simultaneous linear equations.

6. When doing the exercise, the teacher can also point out that, as the intersection point of the graph is the solution of the simultaneous linear equations, we can find the intersection point of the two straight lines by solving the simultaneous equations.

7. The disadvantage of the graphical method is that it is difficult to locate the exact intersection point when the coordinates are not integers.

Remarks on the worksheet:

(1) Both x- and y-axes in graphs should be labelled and corresponding arrows shown.

(2) Straight lines drawn in graphs should be accompanied by their equations.

Simultaneous Linear Equations

Name: _____   **Class:** _____ (   )

1. Solve the following simultaneous linear equations using the method of elimination.

(a) $\begin{cases} x - y = 0 \\ 3x + 2y = 10 \end{cases}$

(b) $\begin{cases} x + 1 = y \\ 3x + y = 5 \end{cases}$

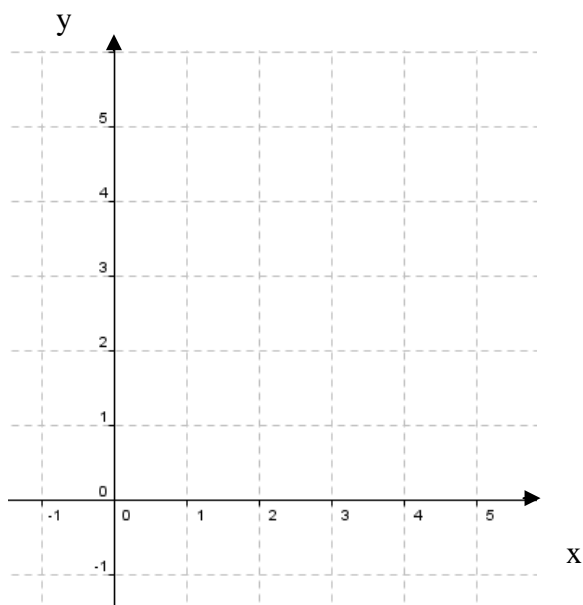(c) $\begin{cases} x = -y \\ x + 2y = 1 \end{cases}$

2. Plot the graphs and locate the point of intersection.

(a) $x - y = 0$ $3x + 2y = 10$
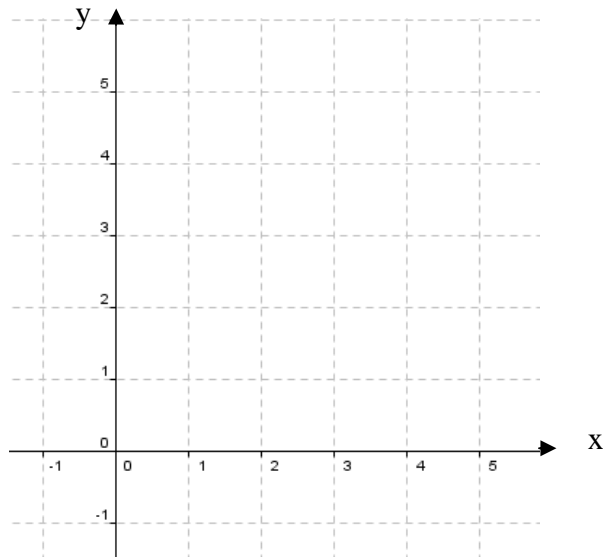
x	0	1	2
y			

x	0	2	4
y			

The point of intersection is (_____ , _____).

(b) $x + 1 = y$ $3x + y = 5$

x	0	1	2
y			

x	0	1	2
y			

The point of intersection is (_____ , _____).

(c) $x = -y$ $x + 2y = 1$

x	0	1	2
y			

x	1	3	5
y			
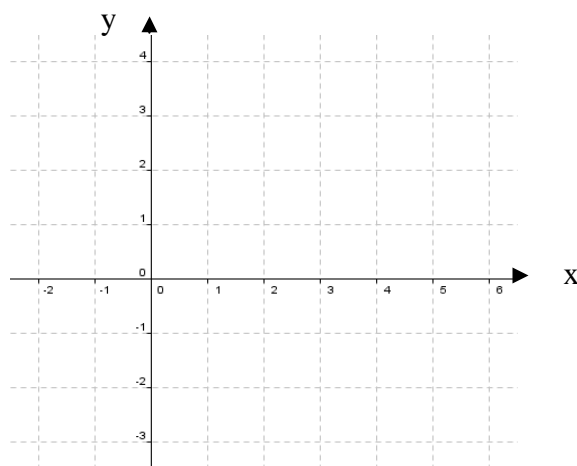
The _____.

3. Study the answers to questions 1 and 2. What can you observe?

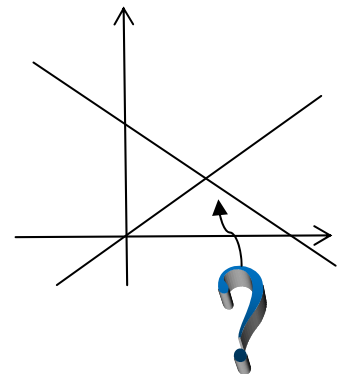4. Discuss your observation with your partner. Explain your observation.

Conclusion:

5. Exercise

a) Without drawing the graph, find the point of intersection of the following two straight lines.
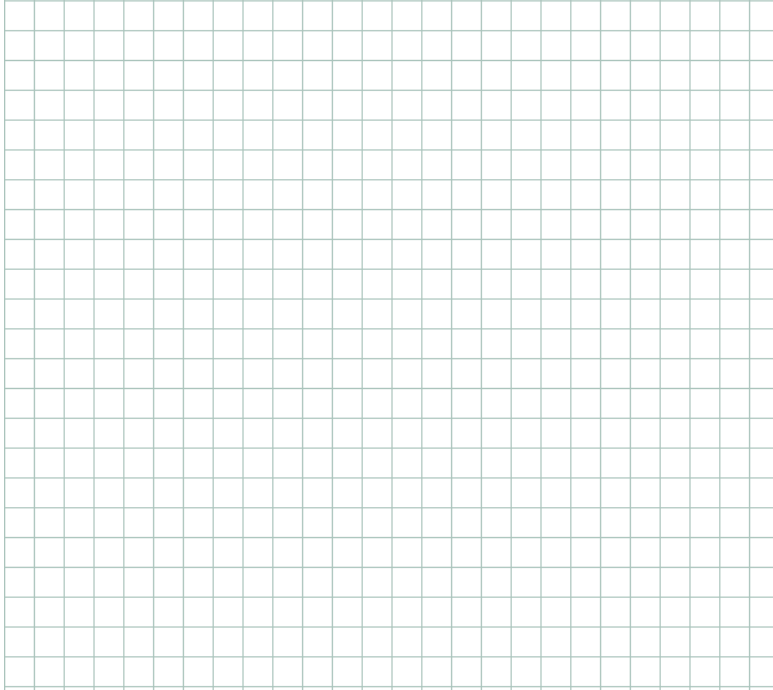
$y - x = 0$ and $2x + y = 9$

The _____.

b i) Solve the following equations graphically.

$$\begin{cases} 3x + y = 1 \\ x + 5y = 26 \end{cases}$$

The _____.

ii) Solve the equations in part (i) using the method of elimination or substitution.

iii) Compare the answers to parts (i) and (ii), which one is more accurate?

iv) What is/are the disadvantage(s) of solving simultaneous linear equations by the graphical method?

Suggested Answers

1a) $x - y = 0$ ----- (i)

$3x + 2y = 10$ ---- (ii)

(i) x 2 + (ii),

$2x-2y+3x+2y =10$

$5x = 10$

$x = 2$

$y = 2$

The solution is x=2, y=2

b) $x+1=y$ --- (i)

$3x+y=5$ ---(ii)

(i) + (ii),

$x+1+3x+y = y+5$

$4x+1 = 5$

$x=1$

$y=2$

The solution is x=1, y=2

c) $x=-y$ ---(i)

$x+2y=1$ ---(ii)

(ii)-(i),

$x+2y-x =1+y$
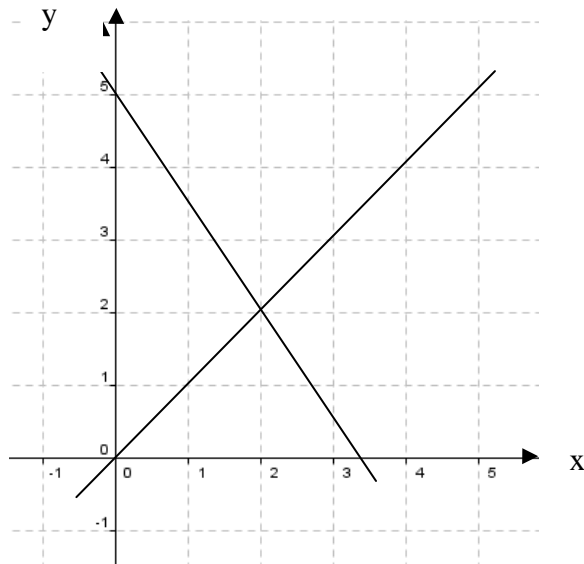
$2y=1+y$

$y=1$

$x=-1$

The solution is x =-1, y = 1

2. Plot the graphs and locate the point of intersection.

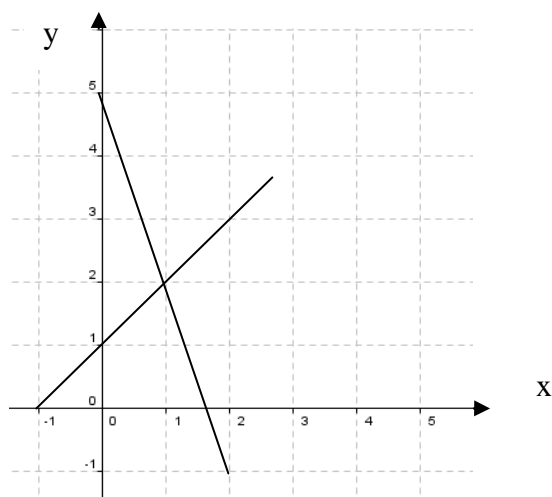a) $x - y = 0$ $3x + 2y = 10$

x	0	1	2
y	0	1	2

x	0	2	4
y	5	2	-1

The point of intersection is (__2__ , __2__).

b) $x + 1 = y$ $3x + y = 5$

x	0	1	2
y	1	2	3

x	0	1	2
y	5	2	-1

The point of intersection is (__1__ , __2__).

c) $x = -y$ $x + 2y = 1$

x	0	1	2
y	0	-1	-2

x	0	1	2
y	0	-1	-2
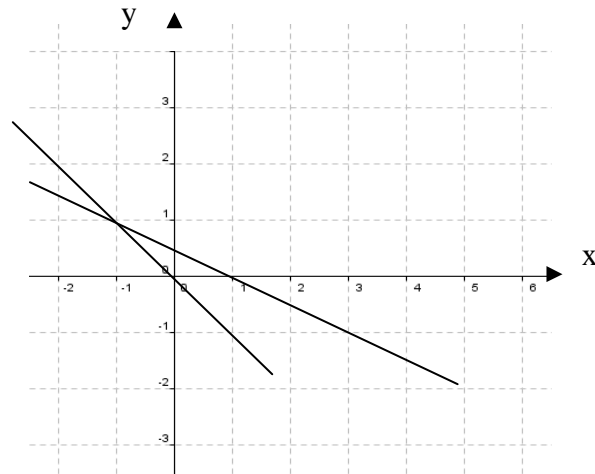
The <u>point of intersection is (-1, 1).</u>

Conclusion: The intersection point of the graph of the two linear equations is the solution
               of the simultaneous linear equations.

5 a) $y - x = 0$ $2x + y = 9$

x=y

2x+y=9

2x+x=9

3x =9

x=3

y=3

The solution is x=3, y=3

As the coordinates of the intersection point are the same as the solution,
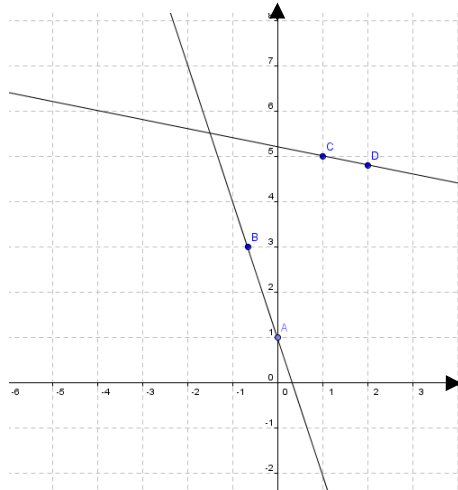
the point of intersection is (3,3).

b i)

$3x + y = 1$ $x + 5y = 26$

x	-1	0	1
y	4	1	-2

x	-4	1	6
y	6	5	4

The <u>solution is x=-1.5, y=5.5</u>

ii) Put y=1-3x into x+5y=26

x+5(1-3x)=26

x+5-15x=26

x=-1.5

y=1-3(-1.5) =5.5

The solution is x<u>=-1.5, y=5.5</u>

iii) The answer in part (ii) is more accurate.

iv) e.g.   It is time consuming to draw the graph

Reading the solution from the graph may not be accurate